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# Results of a Multi-level Intervention to Prevent and Control Childhood Obesity among Latino Children: The Aventuras Para Niños Study

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## Abstract

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**Background—**Community-based behavioral interventions are needed to reduce the burden of childhood obesity.

**Purpose—**This study evaluated the impact of a multi-level *promotora*-based (Community Health Advisor) intervention to promote healthy eating and physical activity (PA) and prevent excess weight gain among Latino children.

**Methods—**Thirteen elementary schools were randomized to one of four intervention conditions: individual and family level (Fam-only), school and community level (Comm-only), combined Fam+Comm intervention, or a measurement-only condition. Participants were 808 Latino parents and their children enrolled in kindergarten through 2nd grade. Measures included parent and child BMI and a self-administered parent survey that assessed several parent and child behaviors.

**Results—**There were no intervention effects on children's BMI z-score. The Fam-only and Fam +Comm interventions changed several obesity-related child behaviors and these were mediated by changes in parenting variables.

**Discussion—**A *promotora*-based behavioral intervention was efficacious at changing parental factors and child obesity-related health behaviors.

**Keywords**

childhood obesity; Latino; diet; physical activity

The prevalence of overweight and obesity among children has been climbing steadily, with 32% of children now overweight and more than 17% obese (1). Mexican American children aged 6-11 years have the highest levels of obesity (25%) when compared to non-Hispanic Whites (19%) and non-Hispanic Blacks (19%) (1). Obesity tracks strongly from childhood and adolescence into early adulthood (2) and Latinos have a greater lifetime risk of developing diabetes compared to non-Hispanic Whites and Blacks (3). Effective childhood obesity prevention programs are needed, especially those targeting disadvantaged subgroups such as Latinos. However, to optimize comprehensiveness and replicability, such programs need to be cast within a conceptual framework that guides the form and sequence of activities. Ecological models of behavior change offer a comprehensive framework to target behavior change at multiple levels (4) and through multiple communication channels (5). Social-Cognitive Theory (SCT) (6) and the Health Belief Model (HBM) (7) provide the framework for targeting specific cognitions and attitudes to support behavior change (SCT: self and family-control; HBM: barriers). Models that are culturally relevant are likely to be more effective than their counterparts (8).

Elder et al., (5) developed a version of the socioecological framework for promoting health in Latino communities. Within their framework, proximal outcomes are primarily behavioral, including chronic disease risk behaviors or protective factors and health care utilization. Proximal influences relevant to child health derive from key individuals in the child's social network, especially family, friends and teachers. More distal to these influences are organizational and community influences, such as school and community physical characteristics (e.g., structure and quality of playgrounds, density and quality of food outlets). Latino health promotion programs often involve *promotores* who serve as

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health advisors to families or who promote broader organizational and community change (9).

Beginning with behavioral targets, important behavioral risk factors for childhood obesity are low physical activity, high sedentary behavior, and consumption of calorie-dense, nutrient-poor foods. Recent estimates confirm that few children are meeting physical activity guidelines: only 42% of 6-11 year olds and 7.6% of 16-19 year olds (10). For cultural, socioeconomic, or other environmental reasons, Latino children spend more time watching TV than non-Hispanic White children (11), which is associated with greater calorie consumption (12), higher BMI levels and more body fat (13). Intake of energy-dense and nutrient-poor foods (14), including sugar-sweetened beverages (15), is associated with overweight. Among Latinos, a notable contributor to consumption of energy-dense foods is away-from-home eating (16).

Extending to the social environment, parents play a critical role in influencing children's behaviors through parental practices and parenting styles (17, 18). The home environment is particularly important to physical activity in poor urban settings that lack safe and accessible recreational facilities (19). Among Latinos, parental control over food, prompting to eat, and feeding styles are associated with children's unhealthy eating patterns and obesity (20). Thus, parent participation in childhood weight control programs is critical for optimal results (21).

Neighborhood environments are related to obesity through several factors including less access to healthy food outlets and recreational facilities, which put poor and minority communities at special risk (22). Given the associations observed between factors at multiple levels of influence and childhood obesity, interventions that simultaneously target these influences are needed. Unfortunately, few community-based environmental change interventions targeting childhood obesity exist.

Studies seeking to prevent and control childhood obesity have obtained limited intervention effects (13-25), while others have demonstrated a reduction in overweight and obesity in children (26-28). Few of these studies involved a partnership with city-wide businesses and organizations to address the problem. One promising intervention engaged school personnel, family members, and city organizations in intervention activities that included modifying the school curriculum, engaging restaurants to modify their menus, and a walk to school programs (29). Making environmental changes is challenging and complicated, necessitating the involvement of stakeholders, community leaders, and community members (30-31). Involving community leaders such as *promotoras* is a culturally sensitive approach for addressing a variety of health issues that impact underserved communities including Latinos (32). *Promotoras* are often from the target communities and have been effective in modifying multiple levels of influence associated with health issues among Latinos (9). Language and cultural factors are taken into consideration when implementing program activities by *promotoras* (33).

Factorial designs are optimal for evaluating the independent and combined effects of multi-level interventions that are attempting to change several health behaviors associated with

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obesity. Testing these types of approaches is urgently needed given the prevalence of childhood obesity among Latinos and evidence documenting the association between the targeted health behaviors and childhood obesity among Latinos. Yet, what is disappointing is that a Cochrane review (2005) showed that studies targeting *only* physical activity or diet produced somewhat more promising results than have those targeting both (34). Nevertheless, given the co-occurrence of health behaviors and the potential inherent in targeting both sides of the energy balance equation compelled us to conduct this study. The purpose of this study was to compare the independent and combined effects of changes in home/family environments versus changes in school/community environments to prevent and control childhood obesity among Latinos. It was hypothesized that children who received a combination of the home/family environment and school/community environment interventions would have lower BMI z-scores compared to children in the other conditions at the end of the three-year intervention. Secondary hypotheses proposed that the combined intervention would result in healthier eating habits and more physical activity in these children compared with the behaviors of children in the other conditions. Moreover, given that the mechanism for behavior change in children's diets and physical activity is through parenting behaviors, it was hypothesized that parent-related changes would influences changes in children's health behaviors.

## Methods

The *Aventuras para Niños* (APN) study was a three-year, 2 × 2 factorial design randomized controlled community trial with thirteen schools randomized to one of four conditions: Home/Family environmental change (Fam-only), Community-only environmental change (Comm-only), Family-plus-Community-environmental change (Fam+Comm), and a no-treatment control condition. The family intervention targeted the home environment and the community intervention targeted the school and community environments via social and physical changes. The primary study outcome was child BMI z-score while secondary behavioral outcomes were child diet, physical activity, and sedentary behavior. Parenting variables were the main targeted mediators of change for the Fam-only intervention.

Detailed study methods for APN have been previously published (35). In brief, a total of 808 parent-child dyads with a child enrolled in kindergarten through second grade were recruited from among 13 participating elementary schools to participate in the evaluation cohort. The Institutional Review Board at San Diego State University approved this study, which took place in the South Bay region of San Diego County, adjacent to the U.S.-Mexico border. All schools in the target region were identified and screened for the following eligibility criteria: 1) Latino enrollment of at least 70%; 2) a defined attendance boundary (no charter or magnet schools); and 3) no other obesity prevention programs or additional physical education training for teachers within the past four years. Project staff contacted the principal of each school, described the study objectives and methods, determined whether inclusion criteria were met, and obtained consent to participate in and be randomized to one of the four conditions. Twenty-five schools were identified, five were deemed ineligible given their current involvement in similar interventions, and seven refused to participate. Parents were recruited directly on school grounds, during school presentations, and through fliers sent home with students. Eligible families self-identified as Latino, had a child in

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kindergarten, first, or second grade who attended one of the 13 schools, had no major health problems that limited participation, lived within the school attendance boundaries, and intended to live in the area for at least one year.

In accordance with the study design, schools were the unit of randomization and individual participants were the unit of analysis. Randomization of schools to study conditions took place immediately after all participants completed baseline measures. Measures were conducted in three measurement waves for feasibility purposes. Table 1 provides an overview of the multilevel intervention components, theoretical approach and fidelity.

### Family/Home (Fam-only) Intervention

Family intervention activities (see Table 1) were delivered by eight *promotoras* who were recruited and selected through schools to ensure their intimate knowledge of relevant neighborhood resources and barriers. Additional inclusion criteria for the *promotoras* included female gender, willingness to commit to the project for at least one academic year, ability to speak and read Spanish, access to personal transportation, and ability to read and write at an $8^{th}$ grade level or higher (Spanish). Candidates were screened using a self-administered application form to assess literacy, followed by an interview to assess important attributes such as approachability, willingness to learn new skills, familiarity with the target community area, appreciation of the importance of preventing childhood obesity, previous community work, and availability to work 15-20 hours per week. Several *promotoras* were known to study staff because of a previous working relationship or were highly recommended due to their experience in community-based health promotion programs.

*Promotoras* received 22 hours of training delivered over 11 sessions using a project-developed curriculum on changing parenting and other aspects of the home environment, childhood obesity, and child nutrition and physical activity needs. The curriculum was informed by previous studies in Latino populations (33-37), as well as Applied Behavioral Analysis (38). *Promotora* training included an orientation to the structure of and materials for the family home visits, as well as opportunities to role-play. Biweekly meetings occurred throughout the intervention period to continue *promotora* skill building, problem-solve difficult situations, and to provide positive reinforcement for completed work. On any given month, each *promotora* worked with 12 to 30 families depending on her availability. The *promotoras* were reimbursed for their travel and time involved in the study.

Details on the delivery of the Fam-only intervention are found in Table 1. Key behaviors targeted during the discussions focused on increasing fruit, vegetable, and water consumption, increasing active play and decreasing sugar-sweetened beverages and TV viewing. Targeted environmental changes included having cut-up vegetables within a child's reach and moving a TV out of a child's bedroom, as well as contingency management such as rules and boundaries set by parents, discipline methods and use of positive reinforcement. When *promotora* turnover required that a new *promotora* be assigned to the family, she was given a folder with notes from all previous family contacts to ensure consistency. During the course of the study, a total of 19% of participants opted to discontinue in-home visits due to time constraints and thus were given the option to switch to receive mailed newsletters.

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### School/Community (Comm-only) Intervention

In accordance with the Structural Model of health behavior (39), the Comm-only intervention was designed to alter physical structures (e.g., playgrounds and salad bars), social structures and policies (e.g., teachers' discipline and classroom practices and public park maintenance), availability of protective or harmful products (e.g., physical education equipment and healthy children's menus in restaurants), and culturally-appropriate media messages (e.g., posters, newsletters, and point-of-choice messages in grocery stores) (see Table 1). Some of the community environmental changes were directly implemented by APN staff and *promotoras*, while others were aimed at adults (including principals, teachers, foodservice workers, restaurant owners, grocery store managers, and local government officials) who controlled aspects of the children's daily environments outside of the home. Comm-only intervention *promotoras* were unaware of whether students at a given school were enrolled in the study. Information was provided to the entire school, particularly the target grade levels, and to the community at large. Given their slowly developing iterative nature, these school programs and community change efforts lasted three years, building or at least maintaining strength over that period rather than tapering down to a “booster” level as in the Fam-only condition. The number of community intervention *promotoras* varied from six to nine, with a final core group of four. Comm-only intervention *promotoras* received two 8-hour training sessions that included the same basic information on obesity, nutrition and physical activity as in the Fam-only intervention *promotora* training, as well as details of the environmental change goals for the schools, an overview of community organizing techniques, and possible community change goals. Ongoing weekly meetings were held with the community intervention *promotoras* to provide additional skills trainings, redirection, encouragement, and positive reinforcement.

As with the Fam-only intervention, the school component of the Comm-only intervention targeted policies and practices as well as physical structures that shape children's choices. For instance, methods of teaching Physical Education (PE) and the types of encouragement children received in making lunch choices were addressed, along with the physical availability of PE equipment and access to a well-stocked salad bar during lunchtime. In the classroom, academic content was incorporated wherever possible to help teachers see the intervention as an enhancement rather than an interruption of the required curricula. The school intervention included several previously developed programs such as a PE program based on SPARK (40), Peaceful Playgrounds® (41) and Take 10!® (42).

APN staff provided follow-up to school staff to reinforce the continued use of the programs and also developed a number of new school interventions, including Start with Salad, which used posters and stickers to encourage vegetable consumption at lunch, Home Fun, and Healthy Classrooms (38). For the Home Fun program, teachers handed out calendars with daily activities for both physical activity and nutrition as homework assignments. Parents were asked to initial each day that their child completed the activity. For the Healthy Classrooms program, teachers were encouraged to make healthy changes to their classroom environments and policies, such as incorporating non-food rewards, disciplining students in ways that did not remove opportunities for physical activity, providing healthy food options

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during classroom parties/celebrations, and increasing access to drinking water during the school day.

In the six schools assigned to the Comm-only and Fam+Comm intervention conditions, all teachers in the target grades participated in a teacher training session at the beginning of the school year. For example, in year one, all teachers in grades K-2 participated in the training sessions, and by year two of the study, third grade teachers received trainings to maintain the dose intensity that was to follow each cohort. Teachers received a shortened SPARK PE curriculum and group training (approximately 4 hours) in PE teaching methods. The group trainings were followed by individual model teaching sessions (30 minutes per teacher), in which the trainer taught each teacher's PE class while the teacher observed, participated and asked questions. In addition to the modified SPARK training, teachers received a brief training on the Take 10!® program, Peaceful Playgrounds®, Home Fun, and Healthy Classrooms (ranged from 60 to 90 minutes). Teachers received a training manual that described each program and were given related materials and activities. Food service workers at each school were trained by the study's registered dietitian on the importance of keeping the salad bars clean and well stocked with fresh produce and on prompting children to select and eat vegetables and fruit for the Start with Salad program. Cafeteria workers were asked to help the *promotoras* with the program by giving children colorful stickers that served as an incentive for them to eat salad or vegetables first when they sat down to eat lunch. Annual booster trainings were conducted at each school to train new teachers and staff and reinforce previously trained teachers and staff.

As part of the community-component of the Comm-only intervention, the *promotoras* received a list of restaurants derived from a county health department list and verified by directly observation of the community by trained research assistants (RAs) with GPS units. The *promotoras* approached 153 locally owned restaurants within a one-mile radius of each of the six intervention schools, and suggested a collaboration to create a healthy children's menu. When restaurant owners agreed, the *promotoras* worked with them to develop menus that fit with the existing ones and met the following guidelines: smaller portions than the regular menu, lower prices, vegetable or fruit side dishes rather than French fries, fewer fried foods, and healthy beverage offerings, or preferably, replacing the choice of sodas. The restaurants received color copies of the menus in English and Spanish and in various sizes, as well as posters to display in windows. Some were laminated for repeated distribution to patrons and some were placed in table stands, along with a wall certificate and laminated window signs announcing the new menus. The *promotoras* continued to visit the restaurants regularly to assess adherence and adoption and to check whether changes were needed in the menus. Participating restaurants received publicity in APN school newsletters, and a list and description of the restaurants and coupons promoting the new children's menus were circulated throughout the community. This effort focused on locally-owned restaurants as managers of fast food and other chain restaurants indicated that any menu changes had to be decided by their corporate offices which was not feasible to pursue given the study timeline and limited resources. Initial contacts with 153 restaurants began in October 2004 with all but two of the restaurants serving Mexican cuisine. Most did not have a children's menu and those that did had no side dishes except French fries listed for children.

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In a second component of the Comm-only intervention, APN staff and *promotoras* developed a program of "frequent produce buyer cards" for local grocery stores. About 4,000 wallet-sized cards were distributed to shoppers and families at participating intervention schools who could present them at the grocery store 'check-out' to be marked each time they bought fresh fruits or vegetables. After nine separate purchases, the shopper received one free pound of fresh fruits or vegetables. The message, "Eat fruits and vegetables and be active," and brief information about the California Food Stamps program was printed on the back of each card in English and Spanish. In collaboration with Latino 5-a-Day, fairs were conducted at each participating grocery store with free giveaways, food demonstrations and tastings, and raffles. The *promotoras* proposed the program to the owners or managers of grocery stores near the intervention schools especially where study participants reported shopping. The most positive response was from locally-owned businesses.

In terms of changes to the community environment to promote physical activity, one of the first goals identified by the *promotoras* was to improve local parks to make them more accessible and attractive to local families. Several parks in San Ysidro, the southernmost portion of the City of San Diego at the U.S.-Mexico border, were in particularly bad condition with few play structures or picnic tables, broken, non-functioning, graffiti-covered playground equipment, non-functioning, graffiti-covered water fountains and bathrooms, and insufficient lighting. Two *promotoras* took photos of the physical conditions of four of the parks, interviewed families, and obtained more than 300 signatures on a petition for improvements, which was presented to the San Diego City Council. In addition, two apartment complex managers were contacted of apartment complexes where a large number of Comm-only condition participants resided. The *promotoras* suggested easing restrictions on children's ability to engage in outdoor activity as parents reported being told to keep children out of common areas and, hence, indoors. Other school and community-level interventions, including cooking classes and 'walking school buses' (44), were not well received by the target audience and were not pursued.

## Control Condition

The control condition consisted of measures only. Participants in the control condition were asked to maintain their regular lifestyles and to attend the yearly scheduled measurements.

## Evaluation Procedures

Data were collected at four time points, beginning during the 2003-2004 school year: baseline (M1), immediate one-year post-intervention (M2), one-year follow-up (M3), and two-year follow-up (M4). Parents completed a self-administered survey available in Spanish and English at their child's school or in their home. Bilingual and bicultural evaluation assistants were available to ensure that participants understood the survey questions and to measure the child's and parent's height and weight. Measurement staff were blinded to participants' study condition.

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## Measures

**Parent and child BMI—**Parent and child height and weight were measured with a portable stadiometer and digital scale according to standard anthropometric procedures (45). Parent and child BMI ($kg/m^2$) was calculated and child BMI-for-age and gender (z-score and percentile) was calculated based on the 2000 CDC growth charts (46). Twenty percent of the anthropometric measurements were randomly selected for reliability assessments. From these, the inter-rater reliability on the anthropometric measures was 97-99%.

**Children's physical activity—**Parents were asked “Compared to children of the same age and sex, how much physical activity does your child get?”. Response options ranged from “1=much less than others” to “5=much more than others.” In previous research, this measure was independently and inversely associated with child BMI z-score (35).

**Children's sports participation—**Parents were asked “During the past year, did your child participate in any youth team sports or clubs?. A summary variable represented the total number of team sports that the child participated in during the past year.

**Active transportation to and from school—**Parents were asked “In a typical week, how many days does your child get to school by…” and “…get home from school by…” The sum of all days the child traveled to and from school by ‘walking, riding a bicycle, or skateboard’ was computed.

**Availability and use of active toys—**Availability and use of activity-promoting toys was assessed by asking the parent to indicate which toys, from a checklist, were available and used by their child. The list of toys included 12 items such as a bicycle, roller skates, balls, Frisbees, etc., and a sum score was created from all toys selected by the parent.

**Parental support for child physical activity—**Support was measured with three questions: “On how many days parents provide 1) encouragement, 2) transportation, and/or 3) actively participate in PA with their child?. Response options ranged from 1 to 7 days a week. A total instrumental support score was created by summing the responses to the three questions ($\alpha$=0.72). Previous analyses indicated that frequency of parental support was associated with perceptions that the child was more physically active than his/her peers (17).

**TV viewing—**Parents reported how often the child viewed TV while getting ready for school, from 1=never to 5=always. TV viewing while eating dinner was assessed with one question, from 1=never to 5=very often. Both questions were developed in a previous study with the target population and the latter was found to be related to child's dietary intake (47).

**Children's dietary intake—**A 49-item food frequency questionnaire assessed children's dietary intake. Parents were asked to rate how often their child consumed each food item, with response options ranging from 1=never to 10=five or more times per day. Item responses were subsequently recoded into number of daily servings. Food items included in the survey were identified from previous studies with the target population (48). Four dietary intake variables were created: number of daily servings of sodas and other sugar-

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sweetened beverages, number of daily servings of water, number of daily servings of sweet and savory snacks/desserts, and number of daily servings of fruits and vegetables.

**Parenting style for diet and activity—**Parenting style was measured with a 26-item scale developed for this project (49), consisting of five subscales: limit setting (6 items), monitoring (7 items), discipline (5 items), control (6 items), and reinforcement (2 items). Response options include frequency (e.g., monitoring: 1=never to 5=always) and strength of agreement (discipline: 1=strongly disagree to 5=strongly agree) options, with a mean score calculated for each subscale ($\alpha$ range from 0.73 to 0.87).

**Behavioral strategies for fat and fiber—**A 30-item scale was used to assess parent behavioral strategies to reduce fat (19 items; $\alpha$=0.73) and increase fiber (11 items; $\alpha$=0.76). This scale was developed for use in a previous study (49) and has acceptable construct and predictive validity (50).

**Family meals together—**Parents were asked “Which of the following meals does your family eat together at least four or more days per week?” A sum score was generated by summing the ‘yes’ responses to breakfast, lunch, and dinner.

**Away-from-home eating—**This dietary behavior was measured with five questions developed in a previous study (51) that asked how frequently (from 1=never to 5=five to seven times per week) families ate away-from-home foods from: relatives' homes, neighbors'/friends' homes, sit down restaurants, fast food restaurants, and restaurants in Mexico. Responses were dichotomized to reflect whether the family consumed away-from-home foods at least once a week or more in each context based on evidence linking weekly consumption with BMI (51). A final summary score reflected the number of locations where away-from-home foods were consumed at least weekly.

**Demographic variables—**Parents responded to open and closed-ended questions that were then recoded as follows: parent and child age (in years) and gender, marital status (married or living as married vs. not married), household income (less than or greater than $1,720/month), homeownership (yes/no), household size (open-ended), level of education (≤ high school vs. > high school), employment status (employed vs. unemployed), and parent and child generation status.

## Statistical Analysis

**Outcome analyses—**All analyses were based on the intention-to-treat approach. Each outcome was examined using mixed effects models for normal outcomes (SAS Proc Mixed) or generalized linear mixed effects models for non-normal outcomes (SAS Proc Glimmix). For non-normal outcomes, appropriate error distribution and link functions were chosen according to the type of outcome. For dichotomous variables (e.g., any youth sport team participation), a logistic-type model was used with a binomial error and logit link. For counting outcomes (e.g., total number of fruits and vegetables per day or total number of snacks per day), either a Poisson or negative binomial regression was chosen according to which provided the best model fit. Models accounted for repeated measures over M2 to M4

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and adjusted for the M1 (baseline) level. All available data were utilized. Thus, although a participant may have data missing at M2, M3, or M4, data available at non-missing time points were still included in the analysis. All models adjusted for parent gender, language of survey, parent age, marital status, household size, employment status, education status, homeownership, parent income, child gender, child age and child generation status. In addition, all models adjusted for clustering at the school level. With one exception, the intraclass correlations (ICC) for the outcome measures ranged from 0 to .019. These ICCs were well within the range anticipated by the study. The lone exception was number of snacks consumed per day with an ICC of .095.

Terms were included in the model to account for the study design consisting of a 2 × 2 factorial (Fam-only: ‘yes’ vs. ‘no’ and Comm-only: ‘yes’ vs. ‘no’) and to account for study time trends. Modeling began with a model including the time-by-Fam-by-Comm interaction and all lower order terms. Non-significant terms ($p>.05$) were eliminated in a hierarchical manner.

**Mediation analyses—**The mediation analyses procedures outlined by MacKinnon et al (52-53) were followed. Mediators are intervening factors that are amenable to change and that explain the relationship between the intervention and the outcomes of interest. As such, the intervention was hypothesized to change the mediator, which in turn changes the outcome. Three regression models were fitted yielding the necessary parameter estimates and standard errors. First, the intervention effect was examined on each dependent variable (carried out in this paper). Second, the intervention effect was examined on each parent mediator (based, in part, on a previous paper from these data) (54). Based on the results of these analyses, outcomes and potential mediators were selected for further evaluation. Results from both models focused on the Fam-only intervention main effect as the primary significant effect of interest. Finally, for each outcome, the intervention effect and each potential mediator were included in the same model. All models adhered to the study design and accounted for the multilevel structure of the data. All models adjusted for the same set of covariates. As described by MacKinnon et al (52), the mediated effect is the result of the product of the unstandardized regression coefficient of the intervention effect in model 2 (coefficient a) and the unstandardized coefficient of the potential mediator in model 3 adjusted for the intervention effect (coefficient b). This product, ‘ab’, is usually assumed to be normally distributed and its significance is often evaluated using Sobel's test. However, ‘ab’ is usually highly skewed and does not follow a normal distribution. MacKinnon et al (53) developed software that provides more accurate asymmetric confidence limits for the product than that provided by Sobel's test. A significant mediated effect at a level of significance of .05 is determined if the confidence interval does not include 0. The software, PRODCLIN, is available as a SAS macro.

**Power Calculation—**The total sample size at year 3 (i.e., M4) was 441, although all participants who contributed at least one measure at M2 through M4 were included in the analyses. Nevertheless a power calculation was done relative to our hypothesized effect sizes based on three years of follow-up. Our effects sizes were based on data from Rosner et al (55) tracking BMI changes in 5 to 8 year old Latino children over three years. The

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average change was 1.99 k/m$^2$. This natural change is what we expected to observe in the control group. Although there were a number of scenarios that we examined, the most conservative assumed that the change in the both Fam and Comm intervention group was 0; that is, BMI does not increase over three years. We assumed that the difference in the control, and the both Fam and Comm intervention group was driven largely by the Fam-only intervention, responsible for 2/3 of the change, and the Comm-only intervention responsible for 1/3. Consequently, the Fam-only intervention main effect was assumed to be 1.33 k/m$^2$ and the Comm-only intervention main effect 0.66 k/m$^2$. We did not hypothesize a specific interaction effect since we had no available information to justify a specific effect size. Utilizing an estimated standard deviation of 2.02 k/m$^2$, the standardized effect sizes were hypothesized to be 0.66 for the Fam-only intervention main effect and 0.33 for the Comm-only intervention main effect.

The clustering attributed to schools yielded ICCs ranging from 0 to .016 (the BMI z-score) depending on outcome. Therefore, .016 is used to account for school clustering. Based on the information above and a significance level of 0.05 (two-sided), power to detect the Comm-only intervention main effect is 80% and power to detect the Fam-only intervention main effect is better than 97%.

## Results

### Participant Characteristics and Retention Rates

Primary analyses were based on data from baseline (M1) to three-year follow-up (M4) representing an overall retention rate of 55% and condition-specific retention rates of 48% (Fam-only), 50% (Fam+Comm), 59% (Comm-only), and 59% (control). Figure 1 depicts the study CONSORT flow diagram. Baseline results, including a detailed description of participant characteristics for the APN study have been previously published (35). Briefly, parent's mean age was 33±6 years, 95% female, 71% were married/living as married, 67% completed high school or less, 72% were foreign-born, 29.7±6.7 mean BMI (kg/m$^2$), 33.8% were overweight, and 41.3% were obese. Children were aged 5.9±0.9 years, 50% were girls, 86% were U.S.-born, 17% were overweight, and 29.5% were obese (35). Analyses were carried out to determine if baseline measures of outcomes were different between subjects who completed the study versus those who dropped out across the four groups of the 2×2 design. Mixed effects models were fitted for each baseline outcome measure with terms in the model for dropout status, group condition and dropout by group condition interaction. The interaction term would determine whether baseline levels across groups varied by dropout status. None of the models found significant interaction terms.

### Intervention Effects

Table 2 shows the child BMI z-scores, percentiles, and proportions of children in the overweight and obese categories by study condition at all time points. No changes in any of these weight measures were statistically significant (Table 5). Children in all conditions increased their overall mean BMI z-score over the course of the study. The proportion of children classified as obese (≥95$^{th}$ percentile weight for age) increased in all except the Fam-only condition at the final measurement (M4); however, this and the Comm-only

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condition evidenced the greatest increase in the overweight category (≥85$^{th}$ <95$^{th}$ percentile). There were also no significant intervention effects on parent BMI or BMI category (data not shown). After adding interaction terms to the models, there was no evidence that intervention effects varied by baseline weight status. We also tested for interactions by child gender and no significant interactions were observed.

**Secondary behavioral outcomes—**Tables 3 and 4 display descriptive statistics for secondary behavioral outcomes. Table 5 shows the specific intervention effects for several of these outcomes. The Comm-only intervention significantly increased parent-reported child PA, reduced child frequency of watching TV when getting ready for school, increased child's daily consumption of fruits and vegetables, and increased behavioral strategies for fat (all significant Comm-only intervention main effects). In addition, the family intervention marginally reduced total number of snacks child consumes per day. There was a significant Fam-by-Comm interaction for child participation in number of team sports. The significant time-by-Fam-by-Comm interaction for parents' use of dietary behavioral strategies to reduce fat was due to the strong community intervention effect at M2 and M3 that diminished at M4. A significant three-way effect for water consumption was difficult to interpret. Although at M3 there was an indication of higher consumption among children in the combined Fam+Comm group, this effect was not replicated at M2 nor M4. Consumption of sugary-sweetened beverages also had a significant three-way effect; at M2 children in the combined Fam+Comm group had a lower mean count than the other three conditions, but this pattern diminished at M3 and M4. No intervention effects were observed for dietary behavioral strategies to increase fiber, child active transport to and from school, child participation in any team sports or use of activity-promoting toys (i.e., none of the interaction terms were significant).

**Mediation effects of secondary outcomes—**Table 6 displays the significant family intervention-related parental and family mediators of child secondary outcomes. These parental mediated factors were selected based on the results of previous analyses of intervention effects on parental factors (54). The ‘ab’ column estimates the mediation effect and the far right column in the table indicates the estimated percentage of the total intervention effect that is mediated by that variable. Results showed that four child behavioral outcomes were significantly mediated by parental factors as a result of the family intervention. Increases in parent-reported child PA were mediated by increases in parental monitoring of children's eating and activity and parent support for child PA. Reductions in child viewing of TV while getting ready for school were mediated by increases in parent monitoring of children's eating and activity. Increases in parent use of behavioral strategies to reduce fat were mediated by increases in parent monitoring and reinforcement for children's eating and physical activity as well as reductions in family viewing of TV during dinner. Increases in child consumption of fruits and vegetables were mediated by increases in parent monitoring and reinforcement and reduction of control of children's eating and physical activity, as well as reductions in family viewing of TV during dinner. Family watching TV during dinner and away from home eating were not included in mediation analyses since they were not affected by the intervention.

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### Environmental Changes

**Restaurants—**Initial contacts with 153 restaurants began in the fall of the second intervention year. Of these, 41 (28%) were chains. This resulted in a final list of 112 non-chain restaurants approached to participate in the intervention and 61 (54%) agreeing to participate. At 16 months, 36 restaurants were still using APN menus.

**Parks—**The 300 signature-petition for park improvements, presented to the San Diego City Council, received unanimous support from a then-newly elected council member who eventually got the Council to award $436,000 to renovate one of the larger parks.

## Discussion

The present study examined the direct and indirect effects of modifying home (parenting) and community (school, park and food retail) environments for the primary prevention of childhood obesity in young Latino elementary school-aged children. This is one of the first initiatives to emphasize the impact of changes across levels of the socioecological model (5) on child BMI z-score. More specifically, it was hypothesized that the “family and community” intervention would have a stronger impact on children's BMI z-score compared to the family or community level intervention alone. Our findings suggest no significant changes in any of the study conditions that are consistent with previous reports (34). Thus, there does not appear to be aggregate effects of the family and community intervention on children's BMI z-score compared to either condition alone. Possible explanations for the null findings related to child BMI z-score may be due to the need for a longer, more intense intervention, or more targeted interventions. For example, in a previous study 60 overweight preadolescent Mexican American children achieved reductions in BMI following an intensive intervention (12 weeks of daily professionally-led sessions, followed by 12 weeks of biweekly sessions) compared with a self-help control (56). However we took a public health approach to childhood obesity prevention and control by targeting multiple levels of influence independently and simultaneously to determine the additive effects of such as an approach. Nevertheless, changes in parenting practices and secondary outcomes such as children's dietary and activity behaviors were achieved among those exposed to the family intervention. Our findings support our second hypotheses suggesting that targeting parenting related factors is likely to impact children's health behaviors. In the present paper, changes in parenting practices such as control, reinforcement, monitoring, and support for child diet and physical activity were related to several corresponding changes in child behaviors (54).

There are a wide variety of possible explanations for the null results in terms of child BMI z-score. It is, of course, conceivable that the significant changes in parental and child behaviors were to a degree products of the fact that they were measured via self-report, while the outcome for the present study was measured through physical assessments of child height and weight. Parents in the intervention condition may have been biased toward socially desirable responses once exposed to the program and therefore may not have recalled their own specific parenting behaviors or their child's behaviors accurately. Alternatively, however, these changes in parental self-report and concomitant changes in the child's food and physical activity environments may have been of insufficient substance to

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have an impact on the child's weight status; a product of genetic, biological, and other forces as well as environmental influences (57). This interpretation is also supported by a recent school-based study, which showed significant reductions in child BMI z-score using strategies to change policy, school environment and parental influences (58). Thus, our intervention may have not been able to achieve sufficiently extensive policy and parenting changes in school and home environments to affect change in child weight.

A second issue challenging the intervention's abilities to show a significant impact may have been related to the heterogeneity in the participants' BMI z-score at baseline. Although “obesity” was not the primary theme of the positive health messages emphasized in the communication with parents, schools, government officials, and retailers, it nevertheless could easily have been inferred by the parents that this was the thrust of the program. Even though intervention staff had substantial flexibility in responding to the needs and realities of individual families, parents of heavier children may have responded differently to these messages than parents of normal weight children. Community-based interventions tend to have a more heterogeneous participant pool given the nature of community recruitment in an intervention contrasted to clinical interventions, which are more able to target individuals at specific risk levels. A recent study of Mexican school children found that a recreation intervention increased physical activity for all children involved, but only those initially overweight benefitted from improved biomarkers related to the metabolic syndrome (59). Thus, future community-based interventions should demonstrate an ability to address multiple levels of risk concurrently.

A third issue that may have limited the studies ability to detect significant intervention effects on child BMI z-score may have been the relatively high attrition rates observed, ranging from 41% to 52% among the four groups. However, these relatively high attrition rates are not uncommon for large community-based trials, especially considering the frequent mobility of our study participants. Most cases of ‘lost to follow-up’ or ‘missing measurement time points’ were due to participants moving from their residence, which made it challenging to track and maintain communication with these participants. Of importance is the fact that retention rates did not appear to differ substantially between the four groups.

Some success was indicated for the program as evidenced by the results of mediational analyses. The family intervention, creating more changes in the child's ‘proximal’ environment (5), appeared to have changed specific parenting practices that resulted in favorable child behavioral outcomes. For example, increased parent monitoring for child diet and PA was related to subsequent increases in parent-reported child PA, increased use of parent behavioral strategies to reduce fat, increased in child consumption of fruits and vegetables, and a reduction in child viewing TV when getting ready for school. These results support the role of parents to influence child obesity-related health behaviors. Past research supports the assertion that excessive parental control over children's eating behavior can result in negative consequences such as increasing child unhealthy eating behaviors (60). Conversely, parental reinforcement and strategic environmental controls of child behaviors are associated with healthy child eating behaviors (61). APN supports previous studies showing associations between parental factors and child behaviors, and suggests that the

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family intervention was a viable method for changing child physical activity and sedentary and dietary behaviors.

Finally, important environmental improvements were achieved; thus, many aspects of this innovative approach proved feasible (62). School cafeteria staff made substantial changes in the way they promoted the selection of healthy foods through the APN ‘Start with Salad’ program. Recesses, physical education classes, and even playgrounds themselves were restructured in ways that promoted more active leisure time among the students in the school. Restaurants and grocery stores as well as the parents became active partners in the promotion of lower calorie and more nutritious food consumption for the children in the targeted neighborhoods. Most importantly, community planners and elected officials were able to understand the decrepit condition of city parks in the targeted neighborhoods and decided to take action to remediate these problems. Thus, relatively permanent or at least medium-term changes were realized in these environments (and not in control neighborhoods). The potential importance of these changes in the ‘distal’ environment should not be underestimated even if they did not produce immediate individual weight changes.

Study limitations include parent self-report survey measures, which are subject to self-report bias. We did not include a measure of social desirability in the survey, which could have been used to adjust for in the analyses. Finally, some measures such as child physical activity consisted of a single parent self-report item. Such measures are less valid than more objective measures (e.g., accelerometry). Thereby, conclusions about the impact of the intervention on these single-item measures are limited.

More research is needed to understand the relative and combined contributions of multilevel factors on childhood obesity as well as the feasibility of changing these factors. Baranowski et al (62) have labeled these childhood obesity research priorities as “behavioral,” “mediator,” and “intervention procedure validation.” Based on our study, it would appear that family intervention strategies should target changes in parenting styles and in other ways restructure the home environment to support physical activity and healthy eating behaviors. Additional research is needed to determine the most effective policy and environmental changes to promote greater physical activity and healthy eating, and whether these two targets can be addressed concurrently (34) and whether intervention strategies are equally effective based on demographic factors such as child's gender. Methodological considerations should include tailoring health messages and intervention strategies based on baseline child weight categories, the frequency of measuring child BMI z-score or the use of multiple body fat measures to improve sensitivity to change, and a determination of how extensive environmental changes must be to favorably alter childhood overweight and obesity rates.

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## References


1. Ogden C, Carroll M, Curtin L, Lamb M, Flegal K. Prevalence of high body mass index in US children and adolescents, 2007-2008. JAMA. 2010; 303:242–249. [PubMed: 20071470]
2. Freedman D, Khan L, Serdula M, et al. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. Pediatrics. 2005; 115:22–27. [PubMed: 15629977]
3. Narayan K, Boyle J, Thompson T, Sorensen S, Williamson D. Lifetime risk for diabetes mellitus in the United States. JAMA. 2003; 290:1884–1890. [PubMed: 14532317]
4. Stokols D. Translating social ecological theory into guidelines for community health promotion. Am J Health Promot. 1996; 10:282–298. [PubMed: 10159709]
5. Elder J, Ayala G, Parra-Medina D, Talavera G. Health communication in the Latino community: issues and approaches. Annu Rev Public Health. 2009; 30:227–251. [PubMed: 19296776]
6. Bandura, A. Social Foundations of Thought and Action. Englewood Cliffs, NJ: Prentice-Hall; 1986.
7. Janz NK, Becker MH. The health belief model: a decade later. Health Educ Q. 1984; 11:1–47. [PubMed: 6392204]
8. Kreuter MW, McClure SM. The role of culture in health communication. Annu Rev Public Health. 2004; 25:439–55. [PubMed: 15015929]
9. Ayala GX, Vaz L, Earp JA, Elder JP, Cherrington A. Outcome effectiveness of the lay health advisor model among Latinos in the United States: An examination by role type. Health Educ Res. 2010; 25:815–40. [PubMed: 20603384]
10. Troiano R, Berrigan D, Dodd K, et al. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc. 2008; 40:181–188. [PubMed: 18091006]
11. Crespo C, Smit E, Troiano R, et al. Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988-1994. Arch Pediatr Adolesc Med. 2001; 155:360–365. [PubMed: 11231802]
12. Matheson D, Killen J, Wang Y, Varady A, Robinson T. Children's food consumption during television viewing. Am J Clin Nutr. 2004; 79:1088–1094. [PubMed: 15159240]
13. Marshall S, Biddle S, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. Int J Obes Relat Metab Disord. 2004; 28:1238–1246. [PubMed: 15314635]
14. Moreno L, Rodríguez G. Dietary risk factors for development of childhood obesity. Curr Opin Clin Nutr Metab Care. 2007; 10:336–341. [PubMed: 17414504]
15. Ludwig D, Peterson K, Gortmaker S. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. Lancet. 2001; 357:505–508. [PubMed: 11229668]
16. Ayala G, Rogers M, Arredondo E, et al. Away-from-home food intake and risk for obesity: examining the influence of context. Obesity. 2008; 16:1002–1008. [PubMed: 18309297]
17. Arredondo E, Elder J, Ayala G, et al. Is parenting style related to children's healthy eating and physical activity in Latino families? Health Educ Res. 2006; 21:862–871. [PubMed: 17032706]
18. Ventura A, Birch L. Does parenting affect children's eating and weight status? Int J Behav Nutr Phys Act. 2008; 5:15. [PubMed: 18346282]
19. Kumanyika S, Grier S. Targeting interventions for ethnic minority and low-income populations. Future Child. 2006; 16:187–207. [PubMed: 16532664]
20. Faith M, Scanlon K, Birch L, Francis L, Sherry B. Parent-child feeding strategies and their relationships to child eating and weight status. Obes Res. 2004; 12:1711–1722. [PubMed: 15601964]
21. Golan M, Crow S. Targeting parents exclusively in the treatment of childhood obesity: long-term results. Obes Res. 2004; 12:357–361. [PubMed: 14981230]
22. Black J, Macinko J. The changing distribution and determinants of obesity in the neighborhoods of New York City, 2003-2007. Am J Epidemiol. 2010; 171:765–775. [PubMed: 20172920]
23. Luepker R, Perry C, McKinlay S, et al. CATCH collaborative group. Outcomes of a field trial to improve children's dietary patterns and physical activity. The Child and Adolescent Trial for Cardiovascular Health. JAMA. 1996; 275:768–776. [PubMed: 8598593]

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24. Caballero B, Clay T, Davis S, et al. Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. Am J Clin Nutr. 2003; 78:1030–1038. [PubMed: 14594792]
25. Gentile D, Welk G, Eisenmann J, et al. Evaluation of a multiple ecological level child obesity prevention program: Switch what you Do, View, and Chew. BMC Med. 2009; 7:49. [PubMed: 19765270]
26. Spiegel S, Foulk D. Reducing overweight through a multidisciplinary school-based intervention. Obesity. 2006; 14:88–96. [PubMed: 16493126]
27. Robinson T. Reducing children's television viewing to prevent obesity: a randomized controlled trial. JAMA. 1999; 282:1561–1567. [PubMed: 10546696]
28. Gortmaker S, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. Arch Pediatr Adolesc Med. 1999; 153:409–418. [PubMed: 10201726]
29. Economos C, Hyatt R, Goldberg J, et al. A community intervention reduces BMI z-score in children: Shape Up Somerville first year results. Obesity. 2007; 15:1325–1336. [PubMed: 17495210]
30. Kelly CM, Hoehner CM, Baker EA, Brennan Ramirez LK, Brownson RC. Promoting physical activity in communities: Approaches for successful evaluation of programs and policies. Eval and Progr Plan. 2006; 29:280–292.
31. Wang S, Brownell K. Public policy and obesity: the need to marry science with advocacy. Psychiatr Clin North Am. 2005; 28:235–252. [PubMed: 15733621]
32. Viswanathan, M., et al. Evidence Report/Technology Assessment 181; AHRQ Publication 09-E014. Agency for Healthcare Research and Quality; Rockville, MD: 2009. Outcomes of community health worker interventions.
33. Rhodes SD, Foley KL, Zometa CS, Bloom FR. Lay health advisor interventions among Hispanics/Latinos: qualitative systematic review. Am J Prev Med. 2007; 33:418–27. [PubMed: 17950408]
34. Summerbell CD, Waters E, Edmunds L, Kelly SAM, Brown T, Campbell KJ. Interventions for preventing obesity in children. Cochrane Database of Systematic Reviews. 2005; (Issue 3)
35. Elder J, Arredondo E, Campbell N, et al. Individual, family, and community environmental correlates of obesity in Latino elementary school children. J Sch Health. 2010; 80:20–30. [PubMed: 20051087]
36. Elder J, Ayala G, Campbell N, et al. Interpersonal and print nutrition communication for a Spanish-dominant Latino population: Secretos de la Buena Vida. Health Psychol. 2005; 24:49–57. [PubMed: 15631562]
37. Elder J, Campbell N, Candelaria J, et al. Project Salsa: development and institutionalization of a nutritional health promotion project in a Latino community. Am J Health Promot. 1998; 12:391–401. [PubMed: 10182091]
38. Baer D, Wolf M, Risley T. Some current dimensions of applied behavior analysis. J Appl Behav Anal. 1968; 1:91–97. [PubMed: 16795165]
39. Cohen D, Scribner R, Farley T. A structural model of health behavior: a pragmatic approach to explain and influence health behaviors at the population level. Prev Med. 2000; 30:146–154. [PubMed: 10656842]
40. Sallis J, McKenzie T, Kolody B, et al. Effects of health-related physical education on academic achievement: project SPARK. Res Q Exerc Sport. 1999; 70:127–134. [PubMed: 10380244]
41. Stratton G, Mullan E. The effect of multicolor playground markings on children's physical activity level during recess. Prev Med. 2005; 41:828–833. [PubMed: 16137756]
42. Stewart J, Dennison D, Kohl H, Doyle J. Exercise level and energy expenditure in the TAKE 10! in-class physical activity program. J Sch Health. 2004; 74:397–400. [PubMed: 15724566]
43. Duerksen, SC.; Campbell, N.; Arredondo, EM., et al. Aventuras para Niños: Obesity prevention in the homes, schools, and neighborhoods of Mexican American children. In: Brettschneider, WD.; Naul, R., editors. Obesity in Europe: Young people's physical activity and sedentary lifestyles. Frankfurt/M u.a.: Pete Lang Publishing; 2007. p. 135-152.
44. Tudor-Locke C, Ainsworth B, Popkin B. Active commuting to school: an overlooked source of childrens' physical activity? Sports Med. 2001; 31:309–313. [PubMed: 11347681]

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45. NCHS. , editor. CDC. National Health and Nutrition Examination Survey III Body Measurements (Anthropometry) Manual. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 1988.
46. Kuczmarski R, Ogden C, Grummer-Strawn L, et al. CDC growth charts: United States. Adv Data. 2000:1–27. [PubMed: 11183293]
47. Andaya A, Arredondo E, Alcaraz J, Lindsay S, Elder J. The Association between Family Meals, TV Viewing during Meals, and Fruit, Vegetables, Soda, and Chips Intake among Latino Children. J Nutr Educ Behav. 2010
48. Zive M, Frank-Spohrer G, Sallis J, et al. Determinants of dietary intake in a sample of white and Mexican-American children. J Am Diet Assoc. 1998; 98:1282–1289. [PubMed: 9813584]
49. Larios S, Ayala G, Arredondo E, Baquero B, Elder J. Development and validation of a scale to measure Latino parenting strategies related to children's obesigenic behaviors. The parenting strategies for eating and activity scale (PEAS). Appetite. 2009; 52:166–172. [PubMed: 18845197]
50. Elder J, Ayala G, Slymen D, Arredondo E, Campbell N. Evaluating psychosocial and behavioral mechanisms of change in a tailored communication intervention. Health Educ Behav. 2009; 36:366–380. [PubMed: 18077657]
51. Ayala G, Mueller K, Lopez-Madurga E, Campbell N, Elder J. Restaurant and food shopping selections among Latino women in Southern California. J Am Diet Assoc. 2005; 105:38–45. [PubMed: 15635343]
52. MacKinnon D, Fairchild A, Fritz M. Mediation analysis. Annu Rev Psychol. 2007; 58:593–614. [PubMed: 16968208]
53. MacKinnon D, Fritz M, Williams J, Lockwood C. Distribution of the product confidence limits for the indirect effect: program PRODCLIN. Behav Res Methods. 2007; 39:384–389. [PubMed: 17958149]
54. Ayala G, Elder J, Campbell N, et al. Longitudinal intervention effects on parenting of the Aventuras para Niños study. Am J Prev Med. 2010; 38:154–162. [PubMed: 20117571]
55. Rosner B, Prineas R, Loggie J, Daniels SR. Percentiles for body mass index in U.S. children 5 to 17 years of age. Pediatrics. 1998; 132:211–22.
56. Johnston CA, Tyler C, McFarlin BK, Poston WSC, Haddock CK, Reeves R, Foreyt JP. Weight loss in overweight Mexican American children: a randomized, controlled Trial. Pediatrics. 2007; 120:e1450–e1457. [PubMed: 18055663]
57. Kral T, Faith M. Influences on child eating and weight development from a behavioral genetics perspective. J Pediatr Psychol. 2009; 34:596–605. [PubMed: 18407923]
58. Foster G, Sherman S, Borradaile K, et al. A policy-based school intervention to prevent overweight and obesity. Pediatrics. 2008; 121:e794–802. [PubMed: 18381508]
59. Macias-Cervantes MH, Malacara JM, Garay-Sevilla ME, Díaz-Cisneros FJ. Effect of recreational physical activity on insulin levels in Mexican/Hispanic children. Eur J Pediatr. 2009; 168:1195–1202. [PubMed: 19142662]
60. Brown R, Ogden J. Children's eating attitudes and behaviour: a study of the modelling and control theories of parental influence. Health Educ Res. 2004; 19:261–271. [PubMed: 15140846]
61. Ritchie L, Welk G, Styne D, Gerstein D, Crawford P. Family environment and pediatric overweight: what is a parent to do? J Am Diet Assoc. 2005; 105:S70–79. [PubMed: 15867900]
62. Baranowski T, Cerin E, Baranowski J. Steps in the design, development and formative evaluation of obesity prevention-related behavior change trials. Int J Behav Nutr Phys Act. 2009; 6:6. [PubMed: 19159476]

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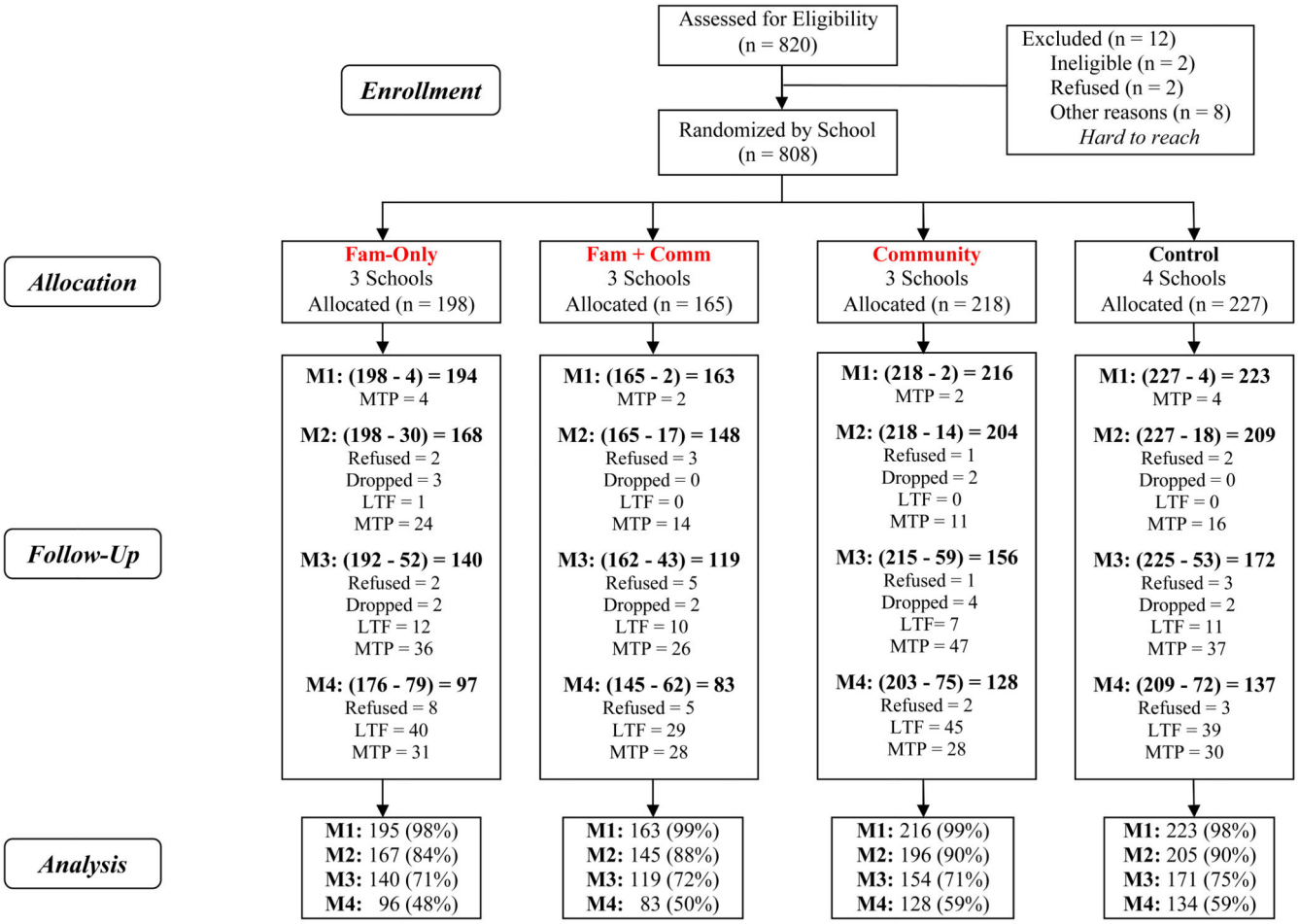


**Figure 1. Participant flow chart following Consolidated Standards of Reporting Trial Guidelines**

M = Measurement time point; MTP = Missing time point; LTF = Lost to follow-up. Fam-only = Family intervention; Comm-only = Community intervention; Fam + Comm = Family-plus-Community intervention

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**Table 1**

Overview of multilevel intervention components, theoretical approach, and fidelity.

| Components | Theoretical Models/Constructs | Delivery Method/Channel | Intended Implementation Frequency | Actual Implementation Frequency |
|---|---|---|---|---|
| **Family Intervention** | | | | |
| **Promotora Home Visits** Newsletters, recipe cards, goal setting | Health Belief Model Barriers Social Cognitive Theory Behavioral Capability, Outcome Expectancies Self Control, Modeling, and Self-efficacy | Promotoras discussed with participants ways to overcome barriers to healthy eating and physical activity, ways to prepare healthy meals in the home, benefits of promoting healthy eating and PA in their children (e.g., behavioral benefits), ways to set appropriate goals for the family and monitor healthy eating in the home, and modeling healthy eating. | 1 per month for 7 months (over one school year) | 53% of participants received all 7 visits (assessed by promotoras' tracking records) |
| **Booster Phone Calls** Goal setting, monitor progress | Discuss barriers (HBM) and Self-control (SCT) | Promotoras called participants | 4 calls | 13% of families received 4 calls (assessed by promotoras' tracking records) |
| **Community Intervention (6 schools)** | | | | |
| School playgrounds (improvements) and salad bars (implementation and improvement); community parks (improvements) | Physical structure (SMHB) | Four Community Promotoras | All playgrounds and salad bars from the 6 schools (for 3 years) | All 6 schools improved their play grounds with Peaceful Playgrounds®; all 6 schools had salad bars, but none improved their display; all community parks were assessed and only one was deemed as needing improvements. This park improved. (all assessed by direct observation by staff) |
| Teachers' discipline and classroom practices; | Social structure and policies (SMHB) | Four Community Promotoras | All classrooms (3 years) | Classroom observations, conducted by staff, indicated that 43% of classrooms allowed water bottles; 52% of teachers reported using TAKE 10!; a assessed by returned calendars; and 53% of teachers reported using Home Fun as assessed by returned calendars. |
| Physical education equipment, children's menus at restaurants | Availability of protective/harmful products (SMHB) | Four Community Promotoras | All classrooms and restaurants (3 years) | Classroom observations, conducted by staff, indicated that 47% of classrooms had equipment for play; 61 (54%) of the restaurants approached agreed to create and modify a healthy menu for children |
| Posters, newsletters, frequent produce buyer cards in grocery stores | Culturally-appropriate media messages (SMHB) | Four Community Promotoras | All participating teachers were asked to place posters in the classroom and distribute newsletter to students about healthy eating; frequent produce buyer cards were distributed throughout the community (3 years) | All 6 schools placed posters on healthy eating, assessed by staff observations; and 90% of teachers distributed newsletter to students, as assessed by staff observations; 7,800 cards were distributed and 287 were returned completed (3.6%) |

SCT = Social Cognitive Theory; HBM = Health Belief Model; SMHB = Structural Model of Health Behavior

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**Table 2**

**Descriptive statistics for child BMI z-score, BMI percentile, and weight status**

| | | Fam + Comm | | Fam-only | | Comm-only | | Control | |
|---|---|---|---|---|---|---|---|---|---|
| **Outcome** | **Time** | **Mean** | ***SD*** | **Mean** | ***SD*** | **Mean** | ***SD*** | **Mean** | ***SD*** |
| BMI z-score | M1 | 0.86 | 1.12 | 0.94 | 1.23 | 0.87 | 1.11 | 1.00 | 1.10 |
| | M2 | 0.86 | 1.06 | 0.95 | 1.13 | 0.85 | 1.09 | 0.99 | 1.12 |
| | M3 | 0.94 | 0.99 | 1.01 | 1.08 | 0.93 | 1.01 | 1.03 | 1.08 |
| | M4 | 0.95 | 1.05 | 1.00 | 1.04 | 0.99 | 1.05 | 0.97 | 1.09 |
| BMI %ile | M1 | 72.15 | 27.28 | 72.64 | 27.30 | 72.15 | 26.87 | 74.84 | 25.50 |
| | M2 | 72.63 | 26.26 | 73.83 | 26.43 | 71.71 | 27.00 | 74.07 | 27.04 |
| | M3 | 75.43 | 23.81 | 74.66 | 25.76 | 74.23 | 25.60 | 75.41 | 25.81 |
| | M4 | 74.62 | 25.85 | 75.08 | 25.48 | 75.49 | 26.67 | 73.51 | 27.24 |
| | | OW | Obese | OW | Obese | OW | Obese | OW | Obese |
| Weight status | M1 | 19% | 27% | 14% | 31% | 19% | 28% | 18% | 31% |
| | M2 | 17% | 27% | 17% | 29% | 19% | 26% | 17% | 33% |
| | M3 | 21% | 26% | 22% | 29% | 21% | 27% | 17% | 35% |
| | M4 | 18% | 32% | 23% | 30% | 20% | 35% | 13% | 35% |

*Note*. BMI %ile = body mass index percentile; OW = overweight; Fam-only = Family intervention; Comm-only = Community intervention; Fam + Comm = Family-plus-Community intervention

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**Table 3**

**Descriptive statistics for child consumption of fruits and vegetables, snacks, sugar-sweetened beverages, and water, and parent behavioral strategies for fat**

| | | Fam + Comm | | Fam-only | | Comm-only | | Control | |
|---|---|---|---|---|---|---|---|---|---|
| **Outcome** | **Time** | **Mean** | ***SD*** | **Mean** | ***SD*** | **Mean** | ***SD*** | **Mean** | ***SD*** |
| F&V | M1 | 1.90 | 3.19 | 1.89 | 2.66 | 1.69 | 2.45 | 1.80 | 2.72 |
| | M2 | 2.04 | 2.54 | 2.19 | 2.50 | 1.50 | 2.03 | 1.68 | 2.41 |
| | M3 | 2.45 | 2.90 | 2.30 | 2.82 | 1.99 | 2.88 | 1.93 | 2.73 |
| | M4 | 2.22 | 2.85 | 2.31 | 2.86 | 1.84 | 2.03 | 2.27 | 2.64 |
| Snacks | MI | 1.39 | 2.85 | 1.74 | 3.81 | 1.39 | 3.47 | 1.51 | 3.48 |
| | M2 | 0.45 | 1.56 | 1.11 | 3.17 | 0.71 | 1.70 | 1.44 | 3.77 |
| | M3 | 1.25 | 3.37 | 0.69 | 1.65 | 1.47 | 3.65 | 1.11 | 2.95 |
| | M4 | 0.95 | 3.16 | 1.64 | 4.87 | 1.02 | 2.59 | 1.04 | 2.54 |
| SSBs | M1 | 0.78 | 1.37 | 0.88 | 1.59 | 0.83 | 1.71 | 0.88 | 1.65 |
| | M2 | 0.39 | 1.12 | 0.58 | 1.30 | 0.56 | 1.26 | 0.83 | 1.64 |
| | M3 | 0.49 | 1.38 | 0.50 | 1.24 | 0.56 | 1.20 | 0.60 | 1.20 |
| | M4 | 0.38 | 1.25 | 0.56 | 1.26 | 0.67 | 1.25 | 0.39 | 0.97 |
| Water | M1 | 2.69 | 1.95 | 2.68 | 1.90 | 2.51 | 1.82 | 2.44 | 1.85 |
| | M2 | 2.68 | 1.87 | 3.12 | 1.74 | 2.60 | 1.86 | 2.76 | 1.83 |
| | M3 | 2.90 | 1.87 | 2.57 | 1.92 | 2.76 | 1.86 | 2.93 | 1.77 |
| | M4 | 2.91 | 1.82 | 3.00 | 1.83 | 3.23 | 1.66 | 2.87 | 1.78 |
| Behavioral | M1 | 2.58 | 0.56 | 2.57 | 0.59 | 2.57 | 0.56 | 2.56 | 0.58 |
| Strategies: Fat | M2 | 2.89 | 0.57 | 2.87 | 0.59 | 2.76 | 0.60 | 2.71 | 0.53 |
| | M3 | 2.89 | 0.55 | 2.89 | 0.56 | 2.76 | 0.60 | 2.82 | 0.56 |
| | M4 | 2.85 | 0.53 | 2.92 | 0.55 | 2.87 | 0.60 | 2.72 | 0.58 |

*Note*. F&V = total number of fruits and vegetables child consumes per day in a typical week; Snacks = total number of snacks child consumes per day in a typical week; SSBs = total number of sugar-sweetened beverages child drinks per day in a typical week; Water = total number of glasses of water child drinks per day on a typical week; and Behavioral Strategies: Fat = total number of behavioral strategies parent uses to reduce fat in family's diet. All analyses were adjusted for parent gender, language of survey, survey version, parent age, marital status, household size, employment status, education status, homeownership status, parent income, child gender, child age, and child generation status; Fam-only = Family intervention; Comm-only = Community intervention; Fam + Comm = Family-plus-Community intervention

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**Table 4**

**Descriptive statistics for child physical activity, sports participation, and TV viewing**

| | | Fam + Comm | | Fam-only | | Comm-only | | Control | |
|---|---|---|---|---|---|---|---|---|---|
| **Outcome** | **Time** | **Mean** | ***SD*** | **Mean** | ***SD*** | **Mean** | ***SD*** | **Mean** | ***SD*** |
| Child PA | M1 | 3.11 | 0.85 | 2.98 | 0.81 | 2.97 | 0.91 | 3.00 | 0.90 |
| | M2 | 3.47 | 0.72 | 3.28 | 0.80 | 3.18 | 0.86 | 3.05 | 0.85 |
| | M3 | 3.36 | 0.92 | 3.36 | 0.85 | 3.13 | 0.85 | 3.14 | 0.83 |
| | M4 | 3.41 | 0.84 | 3.15 | 0.80 | 3.06 | 0.91 | 3.28 | 0.89 |
| Sports | MI | 0.70 | 0.98 | 0.65 | 0.85 | 0.92 | 0.97 | 1.05 | 1.10 |
| | M2 | 1.87 | 1.29 | 1.50 | 1.03 | 1.26 | 0.89 | 1.46 | 1.05 |
| | M3 | 1.75 | 1.26 | 1.95 | 1.36 | 1.42 | 0.92 | 1.78 | 1.08 |
| | M4 | 1.81 | 1.50 | 1.92 | 1.01 | 1.49 | 1.04 | 2.05 | 1.36 |
| TV viewing | M1 | 2.21 | 1.29 | 2.05 | 1.22 | 2.10 | 1.23 | 2.10 | 1.21 |
| | M2 | -- | -- | -- | -- | -- | -- | -- | -- |
| | M3 | 1.99 | 1.27 | 1.95 | 1.09 | 2.18 | 1.23 | 2.04 | 1.12 |
| | M4 | 1.69 | 0.97 | 1.76 | 0.94 | 2.04 | 1.22 | 2.09 | 1.22 |

*Note*. Child PA = child physical activity compared to other children (1=much less to 5=much more); Sports = total number of sports child participated in over the last year; TV viewing = child's frequency of viewing TV while getting ready for school (1=never to 5=always). All analyses were adjusted for parent gender, language of survey, survey version, parent age, marital status, household size, employment status, education status, homeownership status, parent income, child gender, child age, and child generation status; Fam-only = Family intervention; Comm-only = Community intervention; Fam + Comm = Family-plus-Community intervention

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**Table 5**

**Model regression estimates and tests of hypotheses for primary and secondary outcomes**

| | Outcomes | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model Effects** | **BMI z-score** | | **BMI % ile** | | **Weight status** | | **F & V** | | **Snacks** | | **SSBs** | | **Water** | | **Behavioral Strategies: Fat** | | **Child PA** | | **Sports** | | **TV Viewing** | |
| | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** | ***B* (SE)** | **p** |
| Time × Fam × Comm Interaction: | | .49 | | .30 | | .70 | | .75 | | .055 | | | | | | | | | | | | |
| M2/M4 | -.028 (.081) | | -.36 (2.34) | | .44 (.81) | | -.008 (.34) | | .11 (.30) | | .99 (.50) | .027 | .32 (.41) | .026 | .19 (.11) | .003 | -.28 (.20) | .21 | .25 (.34) | .76 | | .58 |
| M3/M4 | -.048 (.067) | | 2.18 (1.93) | | .70 (.83) | | -.22 (.35) | | .72 (.32) | | 1.34(.50) | | 1.16 (.45) | | .39 (.12) | | -.35 (.20) | | .081 (.35) | | .14 (.26) | |
| Time × Comm Interaction: | | .92 | | .94 | | .40 | | .74 | | <.01 | | | | | | | | | | | | |
| M2/M4 | -.003 (.040) | | .20 (1.16) | | .18 (.40) | | .10 (.17) | | -.38 (.17) | | -.17 (.23) | .57 | -.30 (.20) | .27 | -.077 (.053) | .12 | .12 (.097) | .46 | .28 (.17) | .17 | | .14 |
| M3/M4 | -.012 (.033) | | .35 (.96) | | -.35 (.41) | | .13 (.17) | | .56 (.16) | | .02 (.23) | | -.067 (.22) | | -.12 (.058) | | .059 (.10) | | .013 (.17) | | .19 (.13) | |
| Time by Fam Interaction: | | .26 | | .15 | | .78 | | .35 | | .10 | | | | | | | | | | | | |
| M2/M4 | -.059 (.040) | | -2.27 (1.16) | | .087 (.41) | | .24 (.17) | | -.32 (.16) | | .066 (.23) | .96 | .43 (.21) | .10 | .019 (.054) | .76 | .12 (.099) | .26 | .12 (.17) | .77 | | .49 |
| M3/M4 | -.009 (.034) | | -.98 (.96) | | .28 (.41) | | .14 (.17) | | -.26 (.16) | | .062 (.24) | | .14 (.22) | | -.018 (.058) | | .16 (.10) | | .055 (.17) | | .087 (.13) | |
| Comm by Fam Interaction | .016 (.071) | .83 | .25 (1.69) | .88 | -.033 (.63) | .96 | .14 (.23) | .55 | .38 (.43) | .38 | -.32 (.33) | .34 | .22 (.25) | .41 | -.009 (.071) | .90 | .054 (.16) | .74 | .32 (.15) | .035 | -.018 (.19) | .92 |
| Comm Main Effect | -.019 (.033) | .54 | .20 (.84) | .72 | -.19 (.29) | .53 | -.067 (.10) | .52 | -.082 (.21) | .70 | -.13 (.16) | .40 | .025 (.12) | .84 | .016 (.033) | .62 | .09 (.077) | .24 | .12 (.11) | .60 | -.095 (.091) | .29 |
| Fam Main Effect | .003 (.033) | .92 | .72 (.85) | .40 | .036 (.29) | .90 | .27 (.11) | .011 | .42 (.22) | .056 | -.17 (.16) | .29 | .044 (.12) | .72 | .13 (.033) | <.0001 | .21 (.078) | .008 | .29 (.11) | .11 | -.20 (.093) | .033 |

Fam = Family intervention; Comm = Community intervention; Fam + Comm = Family-plus-Community intervention

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**Table 6**

**Results of family intervention mediation analyses for select parental and family factors on select secondary child behavioral outcomes**

| | | | | 95% CI for ab | | |
|---|---|---|---|---|---|---|
| **Outcome with Mediators** | **a** | **b** | **ab** | ***LL*** | ***UL*** | **% med** |
| Child PA | | | | | | |
| Parent monitoring of diet & PA | .1353 | .1036 | .01402* | .0026 | .0296 | 7.0 |
| Parent control of diet & PA | -.3069 | -.0013 | .00039 | -.0136 | .0145 | 1.9 |
| Parent reinforcement diet & PA | .2116 | .0752 | .01591* | .0043 | .0317 | 7.7 |
| Parental support for PA | .3694 | .1163 | .04296* | .0229 | .0665 | 21.7 |
| Sports | | | | | | |
| Parent monitoring of diet & PA | .1353 | -.0266 | -.00360 | -.0178 | .0084 | 1.1 |
| Parent control of diet & PA | -.3069 | -.0462 | .01418 | -.0074 | .0400 | 4.2 |
| Parent reinforcement diet & PA | .2116 | .0335 | .00709 | -.0077 | .0250 | 2.2 |
| Parental support for PA | .3694 | .0437 | .01614 | -.0037 | .0395 | 5.1 |
| TV viewing | | | | | | |
| Parent monitoring of diet & PA | .1353 | -.1943 | -.0263* | -.0541 | -.0051 | 13.7 |
| Parent control of diet & PA | -.3069 | -.0482 | .01480 | -.0078 | .0419 | 6.6 |
| Parent reinforcement diet & PA | .2116 | -.0484 | -.01024 | -.0302 | .0052 | 5.5 |
| Behavioral Strategies: Fat | | | | | | |
| Parent monitoring of diet & PA | .1353 | .0895 | .01212* | .0025 | .0238 | 9.2 |
| Parent control of diet & PA | -.3069 | -.0243 | .00745 | -.0002 | .0172 | 5.6 |
| Parent reinforcement diet & PA | .2116 | .0599 | .01269* | .0041 | .0236 | 9.3 |
| Away from home foods | -.1679 | -.0095 | .00160 | -.0022 | .0066 | 1.2 |
| Family watches TV during dinner | -.1871 | -.0291 | .00544* | .0008 | .0122 | 4.1 |
| F&V | | | | | | |
| Parent monitoring of diet & PA | .1353 | .1779 | .02407* | .0044 | .0510 | 9.0 |
| Parent control of diet & PA | -.3069 | .0880 | -.02701* | -.0575 | -.0037 | 8.2 |
| Parent reinforcement diet & PA | .2116 | .0976 | .02065* | .0032 | .0453 | 7.5 |
| Away from home foods | -.1679 | -.0247 | .00415 | -.0074 | .0189 | 1.5 |

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| | | | | 95% CI for ab | | |
|---|---|---|---|---|---|---|
| **Outcome with Mediators** | **a** | **b** | **ab** | ***LL*** | ***UL*** | **% med** |
| Family watches TV during dinner | -.1871 | -.0813 | .01520* | .0017 | .0349 | 5.6 |

*Note*. a = Family intervention effect on mediator; b = mediator effect on outcome adjusting for intervention; ab = mediated effect; CI = confidence interval; LL = lower limit; UL = upper limit; % med = proportion of the absolute total effect that is mediated; Child PA = child physical activity compared to other children (1=much less to 5=much more); Sports = total number of sports child participated in over the last year; TV viewing = child's frequency of viewing TV when getting ready for school (1=never to 5=always); Behavioral Strategies: Fat = total number of behavioral strategies parent uses to reduce fat in family's diet; and F&V = total number of fruits and vegetables child consumes per day in a typical week.

* $p < .05$.